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(54) **ORTHODONTIC BRACKET HAVING AN ARCHWIRE CHANNEL AND ARCHWIRE RETAINING MECHANISM**

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CPC ... ***A61C 7/28*** (2013.01); ***A61C 7/14*** (2013.01); ***A61C 7/145*** (2013.01); *A61C 7/143* (2013.01)

(58) **Field of Classification Search**

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See application file for complete search history.

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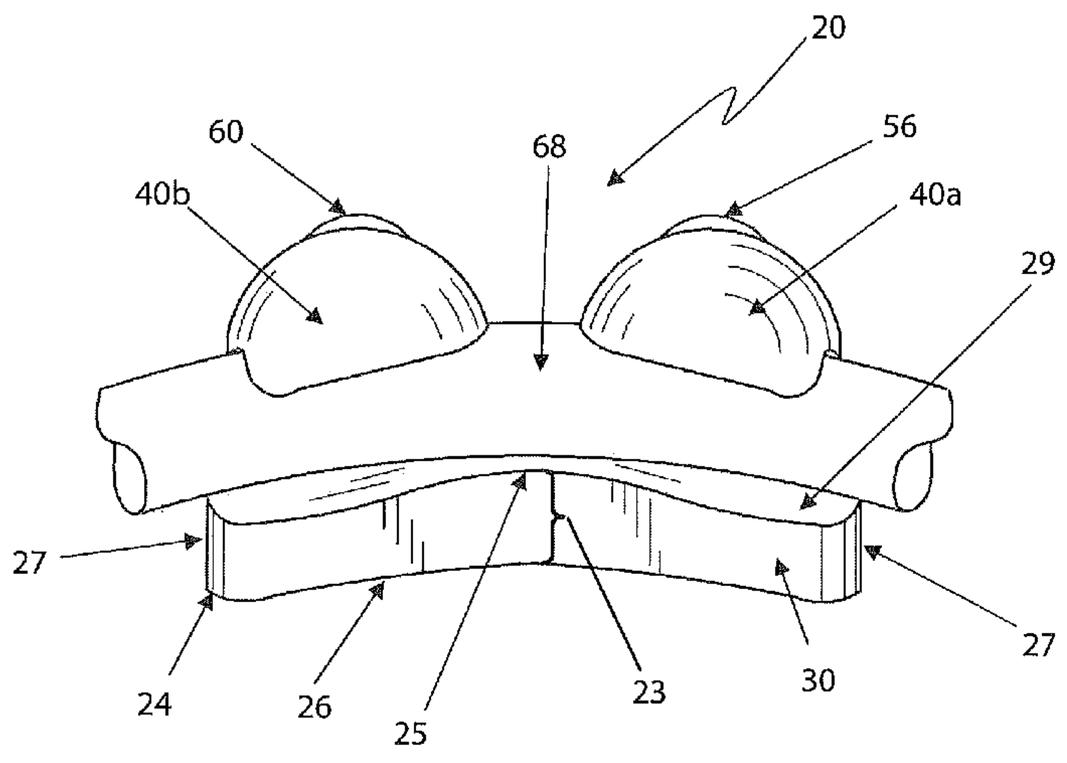
(57) **ABSTRACT**

An orthodontic bracket is disclosed having three archwire retention channels in the mesial-distal directions, a central channel and two side channels. The two side channels each include a pair of spaced apart inverted archwire retaining regions having a recess that opens generally towards the bracket base. Each such recess is for grasping or holding an archwire therein. Each of the side channels has an archwire retaining ridge extending gingivally-occlusally along the adjacent side of the bracket base between the two retaining regions of the channel. For each channel, its retaining ridge exerts a force on a portion of an archwire facing away from the archwire portion residing in the recesses of the retaining regions of the channel. The force on the archwire is directed toward the interiors of the recesses of the retaining regions for assisting in seating the archwire in the recesses.

20 Claims, 7 Drawing Sheets



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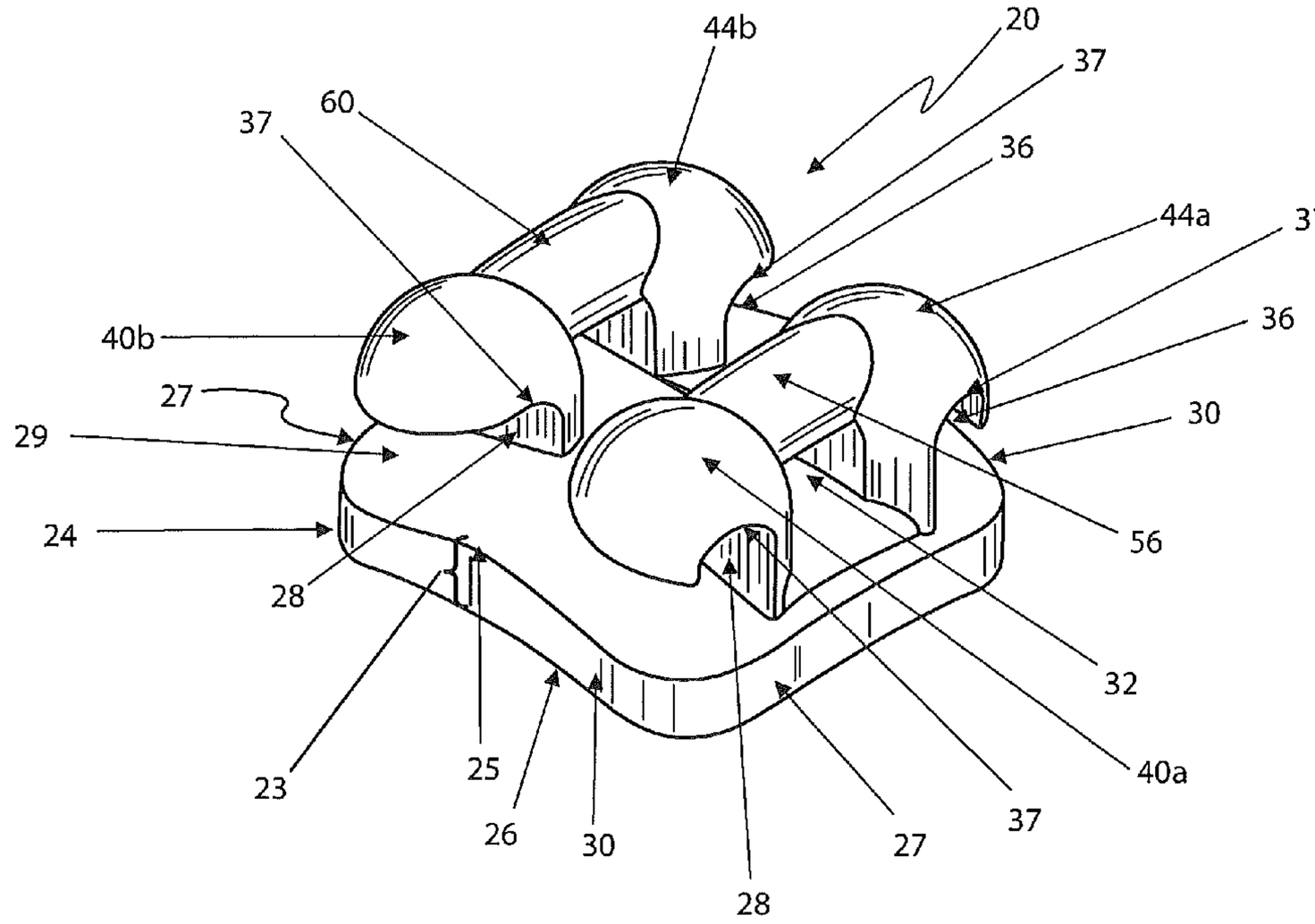
44b
20
37
60
37
36
44a
37
36
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27
29
30
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56
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32
40a
23
25
26
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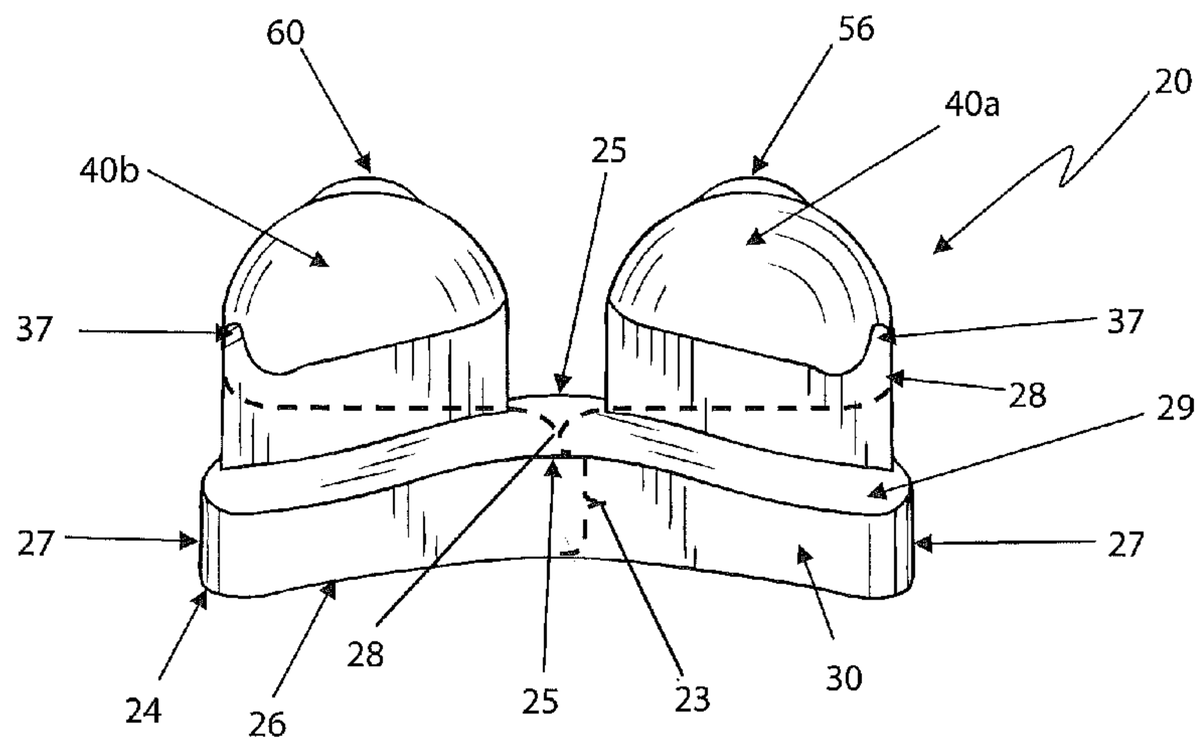
37
27
28

Fig. 1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40a
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27
24
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28
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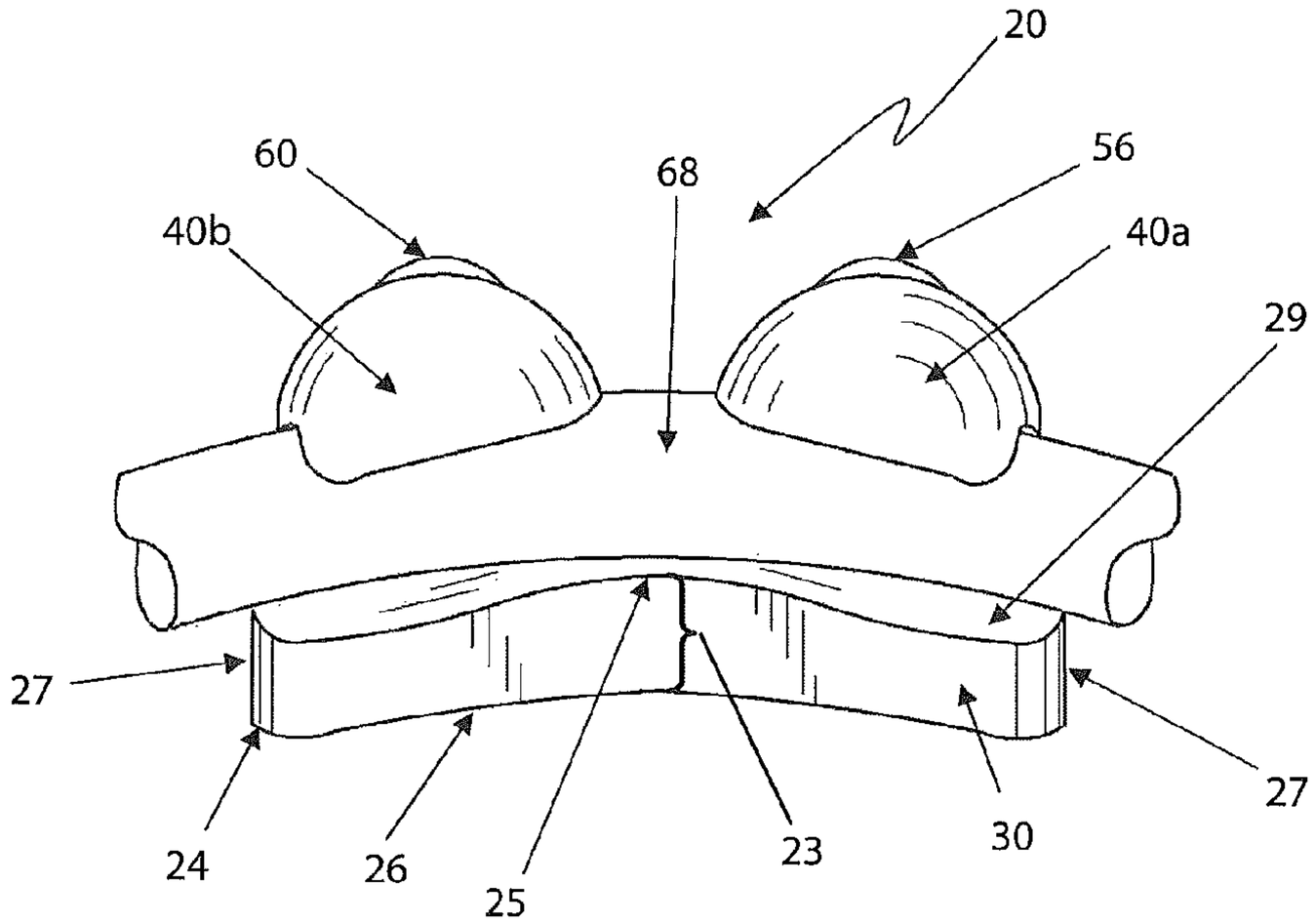
23
30

Fig.2A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60
68
56
40b
40a
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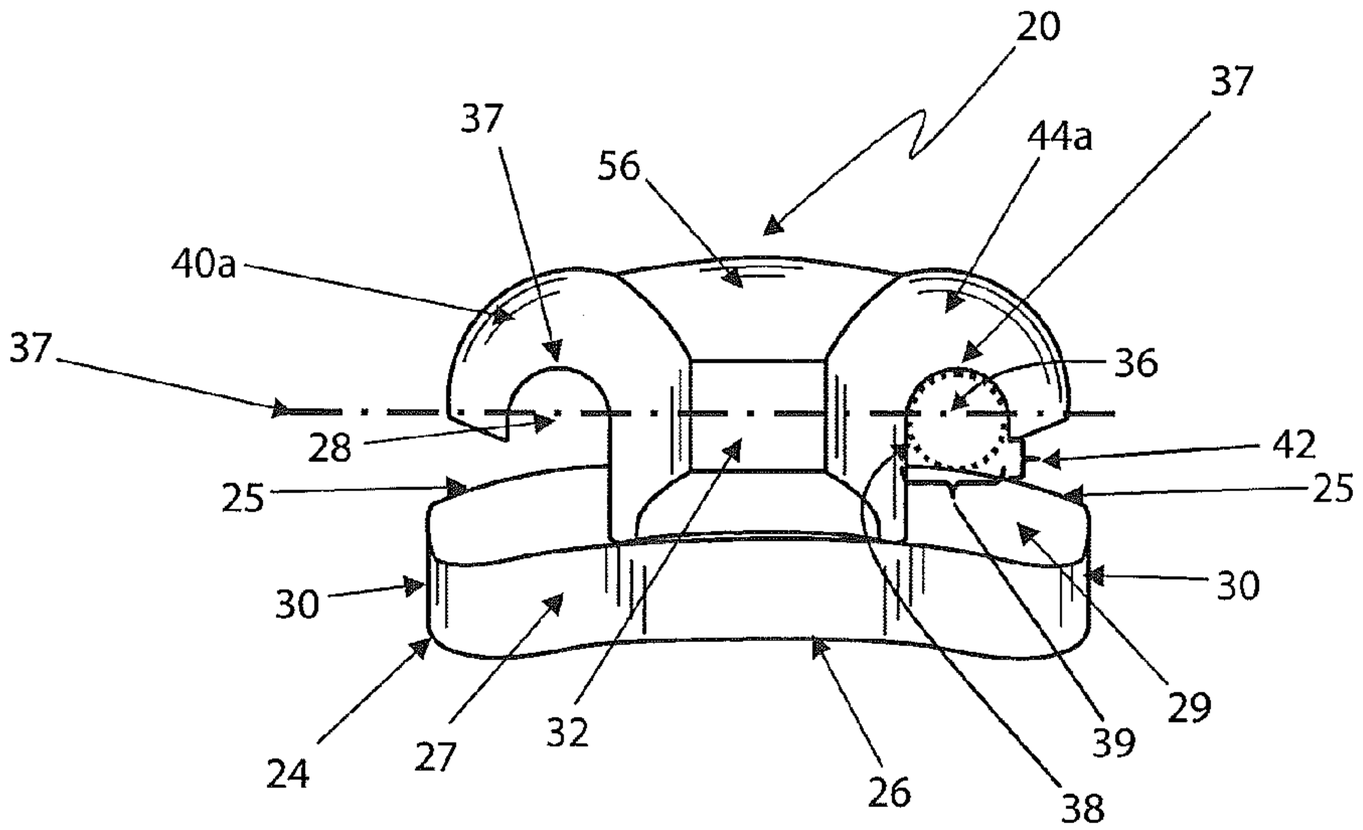
27
24
26
25
23
30
27

Fig. 2B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37
37
44a
56
40a
37
36
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25
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32
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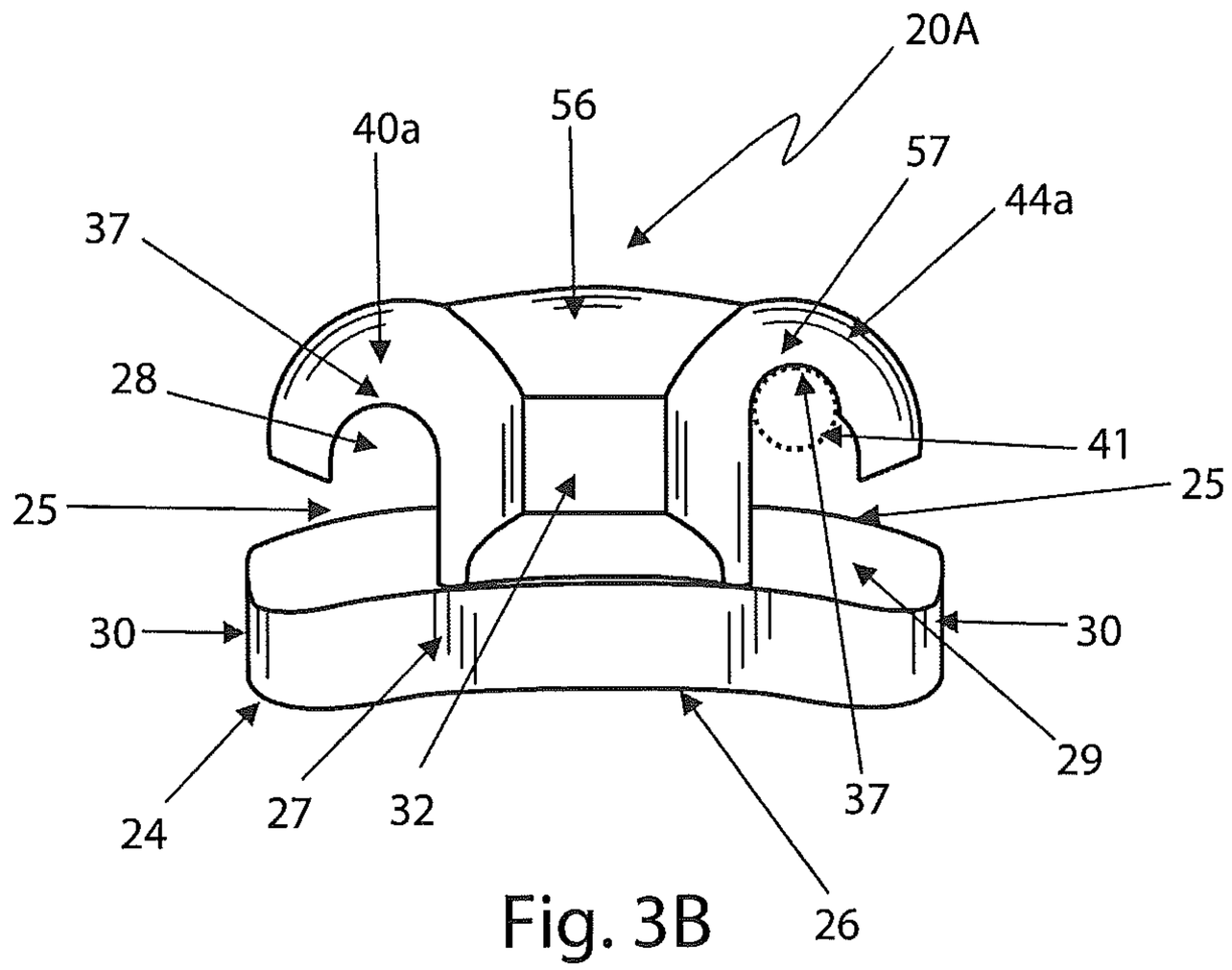
29
38

Fig. 3A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57
44a
37
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41
25
25
30
30
29
24
27
32
37
26

Fig. 3B

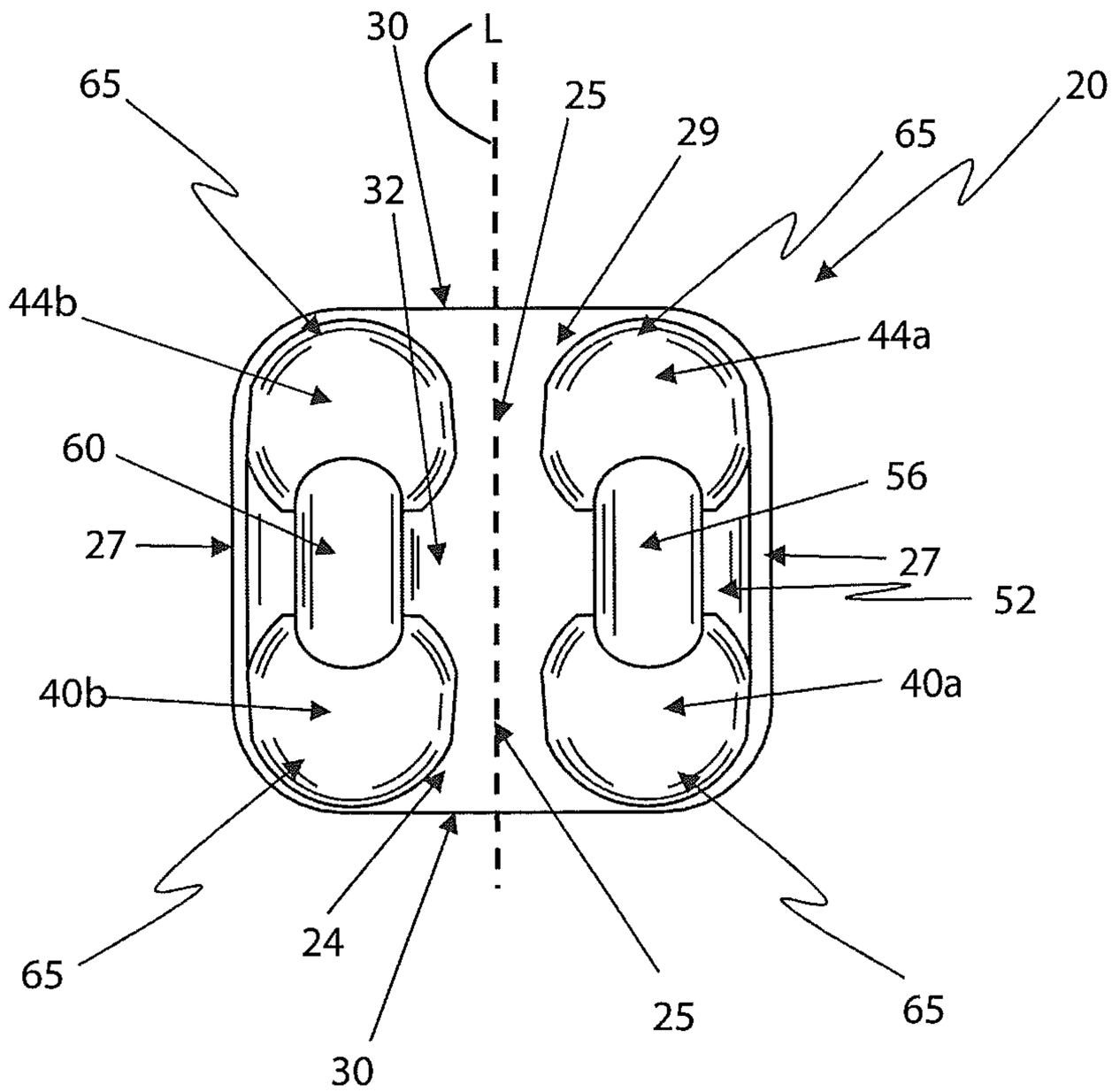
30
L
65
25
29
65
20
32
44b
44a
60
56
27
27
52
40b
40a
65
24
25
65
30

Fig. 4

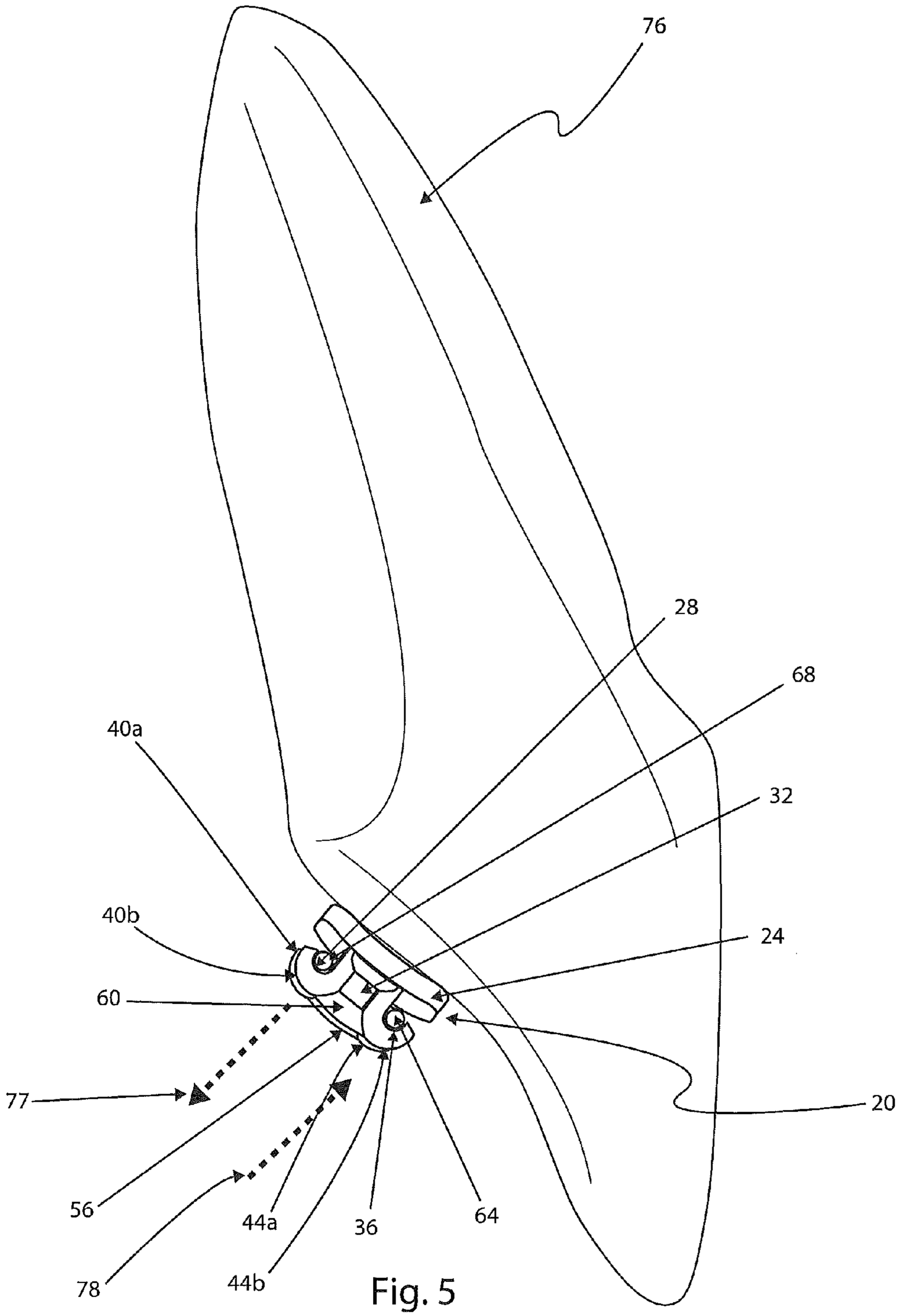

Fig. 5

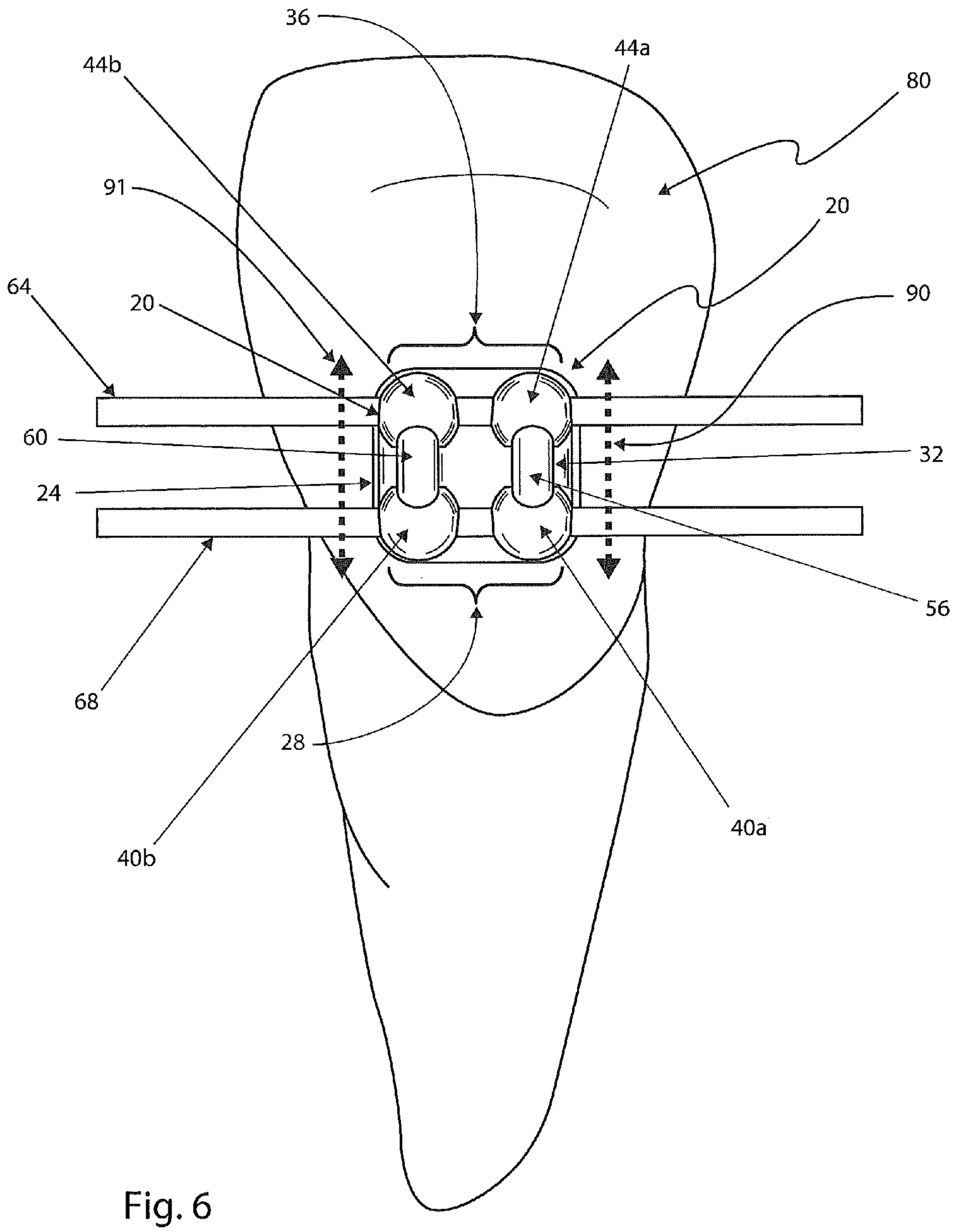

Fig. 6

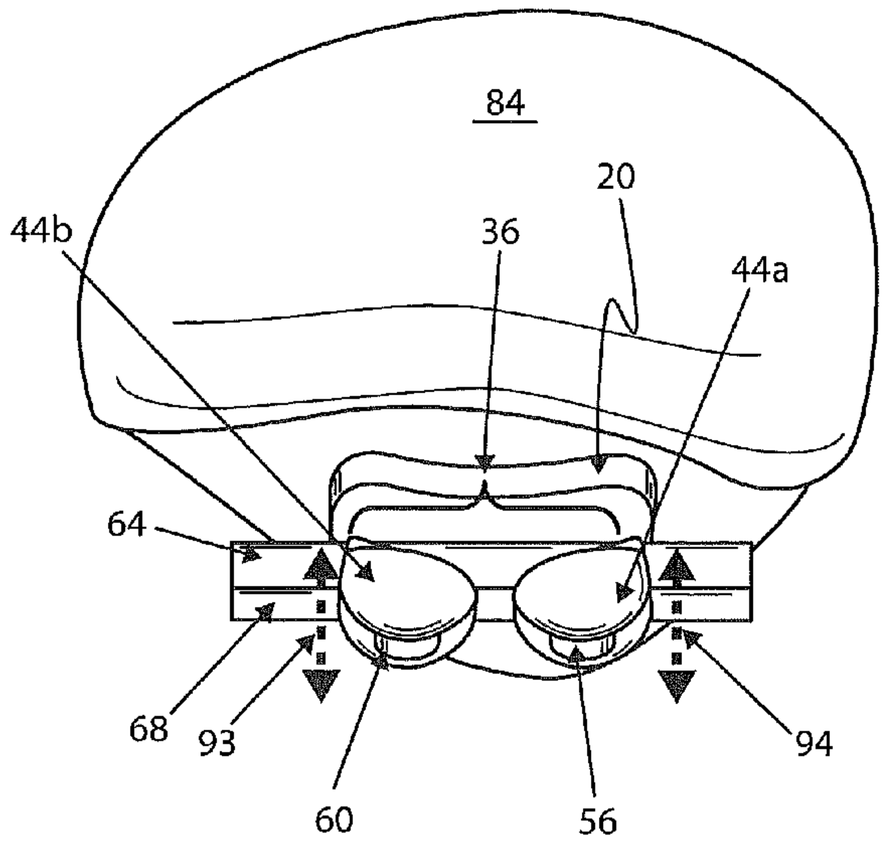

Fig. 7

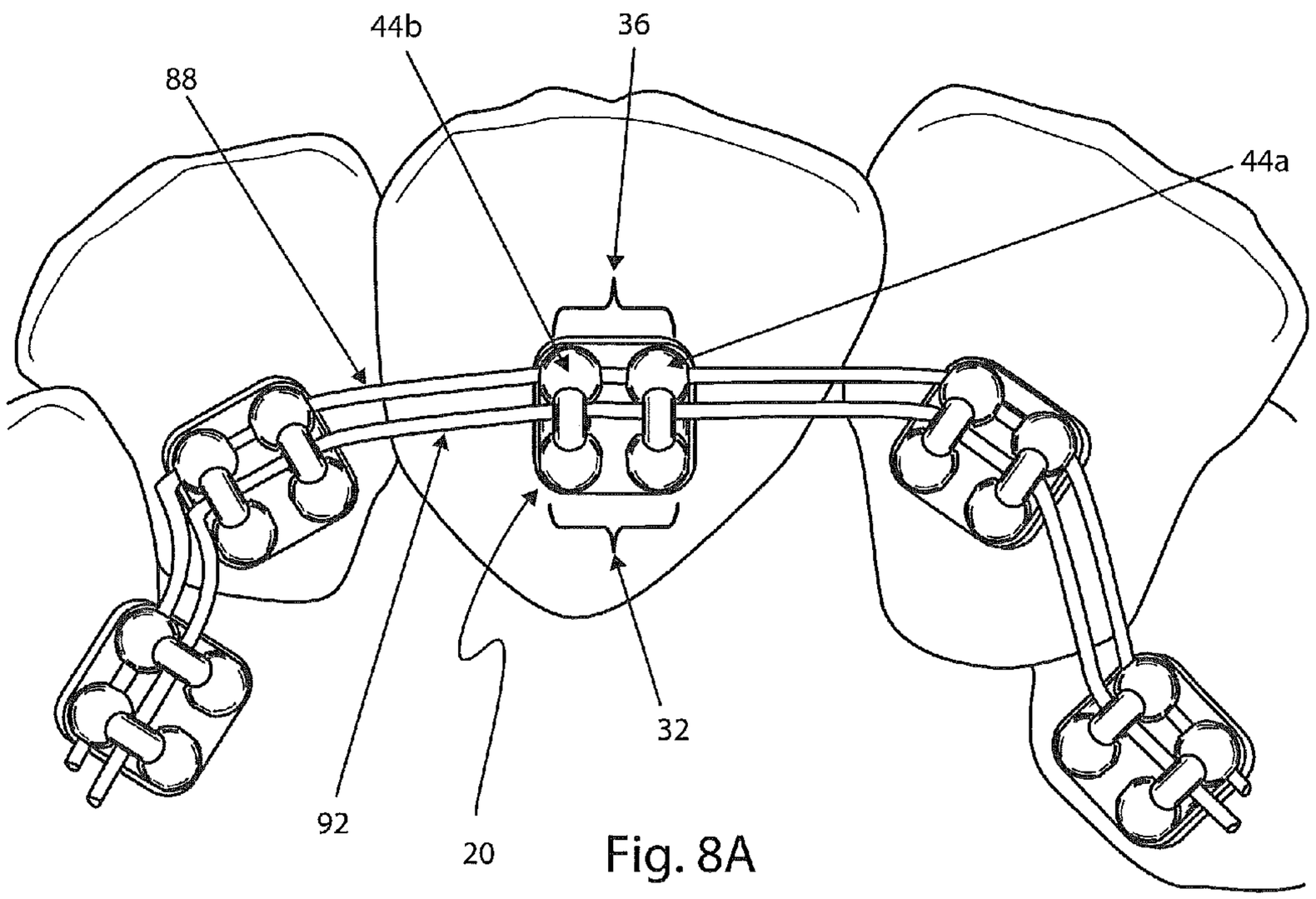

Fig. 8A

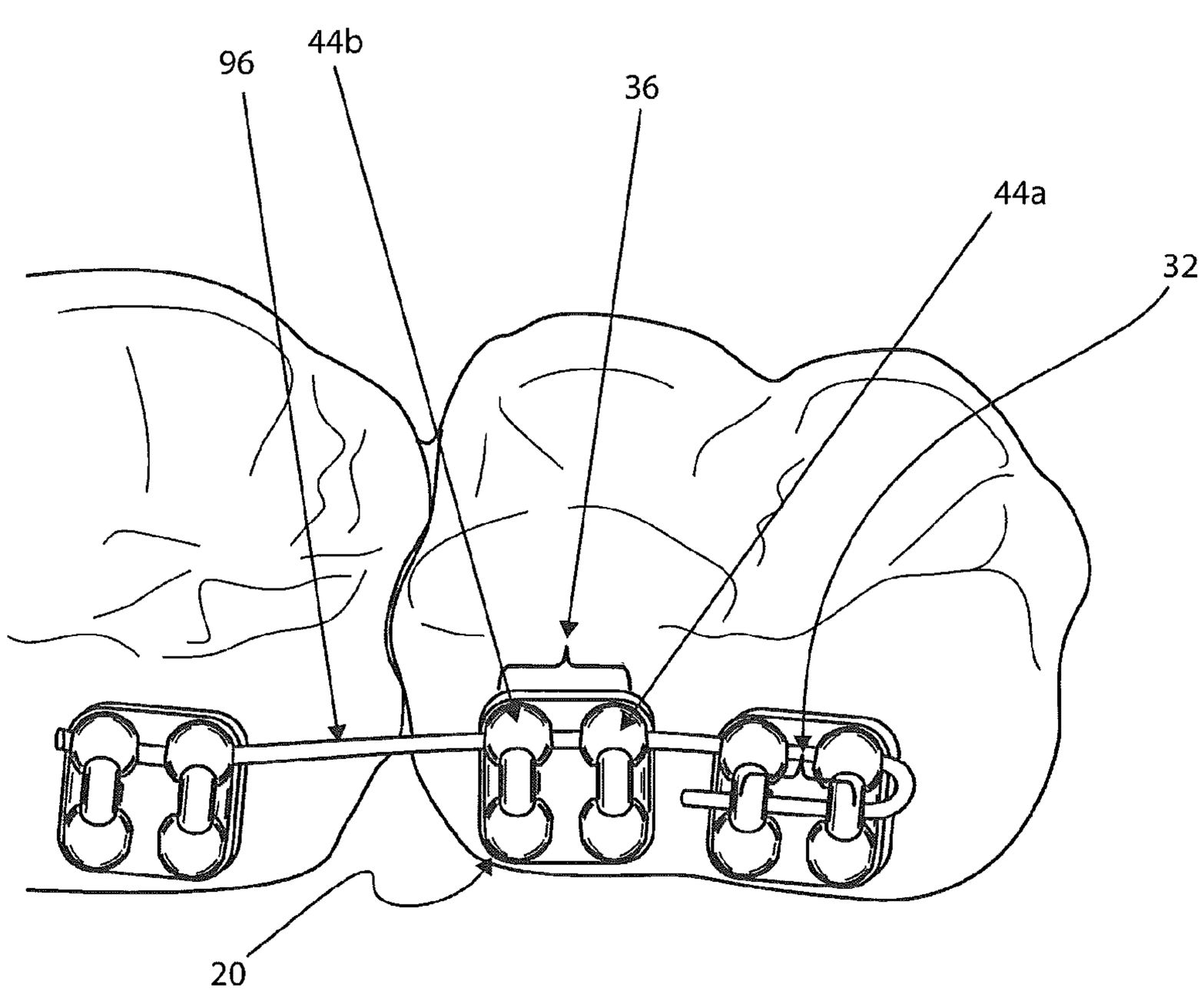

Fig.8B

ORTHODONTIC BRACKET HAVING AN ARCHWIRE CHANNEL AND ARCHWIRE RETAINING MECHANISM

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 12/724,159, filed Mar. 15, 2010, and claims the benefit of U.S. Provisional Patent Application Ser. No. 61/160,653, filed Mar. 16, 2009. The entire disclosure of the prior application hereinabove is incorporated herein fully by reference.

RELATED FIELD OF THE INVENTION

The present invention is related to orthodontic brackets, and in particular, to such brackets wherein one or more archwires can be secured in laterally entered archwire retaining channels.

SUMMARY OF THE INVENTION

An orthodontic bracket is disclosed herein for retaining one or more archwires in position. The bracket includes a base having a tooth affixing side and an opposing side, and there is one or more archwire retention channels extending in the mesial-distal directions. Each of the archwire retention channels includes a pair of inverted archwire retaining regions on one side of the channel, wherein each of the retaining regions, in turn, includes a recess that opens generally towards an opposing side of the channel, the opposing side being, in one embodiment, part of the bracket base. Each such recess is for grasping or holding an archwire within the channel having the recess. A first of the archwire retention channels includes a first pair of gingivally located inverted archwire retaining regions whose recesses hold a common archwire. In an embodiment of the bracket having more than one archwire retention channel, a second of the archwire retention channels includes a second pair of occlusally located inverted archwire retaining regions whose recesses hold another archwire. Moreover, for each of the archwire retention channel(s), there is a corresponding archwire retaining ridge extending gingivally-occlusally along the opposing side bracket base between the two archwire retaining regions of the channel, wherein this retaining ridge contacts a portion of an archwire that faces away from the archwire portion being held in the recesses of the inverted archwire retaining regions for the channel. Accordingly, for each pair of archwire retaining regions and an archwire held by the pair, the corresponding archwire retaining ridge exerts a force on the archwire directed toward the interiors of the recesses of the inverted retaining regions of the pair. In particular, this force assists in seating the archwire in the retaining regions of the pair.

In particular for the at least one of the archwire retention channel included in the bracket and an archwire provided therein, the elasticity of the archwire to retain an initial non-curved shape causes the archwire to resist a channel induced bow in the archwire (such bowing or curving shown in FIG. **2**B). Thus, as an orthodontist positions the archwire in the at least one channel of the bracket, the corresponding retaining regions for the channel together with the corresponding retaining ridge, bind or wedge the archwire within the channel. Accordingly, the opposing forces between the channel and archwire secure the archwire within the channel. Thus, it is a feature of the bracket **20** that for each such archwire channel, there are channel archwire bowing portions that retain the archwire within the channel, wherein a spaced apart plurality of these bowing portions (e.g., **40***a* and **40***b* for channel **28**) contact the archwire at spaced apart locations on one side of the archwire's length, and wherein between such locations, there is at least one additional channel archwire bowing portion on an opposite side of archwire for inducing the archwire to press against the spaced apart plurality of contacting portions. Thus, the spaced apart plurality of bowing portions, and the at least one additional bowing portion induce oppositely directed forces on the archwire (such forces being traverse to the length of the archwire), and causing the archwire to bow or bend somewhat and to press against these bowing portions for holding the archwire within the channel. Said differently, the channel effectively is effectively bowed along its length.

In some embodiments, one archwire retention channel may be configured to provide more than a single bow or bind of the archwire within the channel. In particular, such a channel may be configured so that an archwire contained therein must form at least one "S" shape with the channel.

The novel bracket preferably has a generally square bracket base with opposing mesial-distal sidewalls, and opposing gingival-occlusal sidewalls that extend between the tooth affixing side and the opposing side (also referred to as an "upper side" herein). Each of the above described retaining ridges is provided by a corresponding thickened portion of the bracket base that extends in the gingival-occlusal direction of the bracket approximately along a gingival-occlusal occlusal center line of the bracket base. The thickened portion gradually thins in the mesial-distal direction of the bracket, ending with the same thickness as the gingival-occlusal sidewalls.

Two archwire retention bridges are also included on the novel bracket, wherein each end of each bridge includes one of the inverted archwire retaining regions from a different one of the first and second pairs identified above. A central archwire retention channel (positioned between the two archwire retention channels described above) extends in the mesial and distal direction along a central portion of the bracket. This channel is formed by the two archwire retention bridges which enclose spaced apart portions of the archwire retention channel for securing an archwire therein.

Embodiments of the bracket may be made of stainless steel for strength or other materials, including ceramics, plastics, polycrystalline alumina material, alumina (aluminum oxide), and zirconia. The bracket base design allows for the bracket to be used in both direct and indirect bonding to patients' teeth. Embodiments of the bracket may be formed via an injection molding technique.

Such a universal bracket design may be primarily attached to the lingual side of patients' teeth, but for embodiments of the bracket attached the labial/buccal side of a patients' teeth, the bracket base tooth facing curvature may be specific to particular tooth types.

This Summary section is neither intended nor should be construed as being representative of the full extent and scope of the present invention. Various embodiments of the present disclosure are set forth in the attached figures and in the detailed description hereinbelow and as embodied by the claims. Accordingly, this Summary does not contain all of the aspects and embodiments of the present disclosure, and is not meant to be limiting or restrictive in any manner. Furthermore, the disclosure should be understood by those of ordinary skill in the art to encompass obvious improvements and modifications thereto.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. **1-8** illustrate various views and embodiments of novel brackets according to the present disclosure. The drawings are not necessarily drawn to scale.

FIG. **1** is a perspective view of a bracket **20** illustrating novel features for an orthodontic bracket.

FIG. **2**A is a gingival view of the bracket **20** of FIG. **1**, wherein the retaining ridge **25** and the archwire retention channel **28** are shown.

FIG. **2**B is a gingival view of the bracket of FIG. **1** with an archwire **68** passing through archwire retention channel **28** (as shown in FIG. **2**A), wherein the archwire is held in place in the retaining regions **40***a,b* by, e.g., the retaining ridge **25**.

FIGS. **3**A and **3**B are side views of the bracket **20** of FIG. **1** looking through the archwire retention channels **28**, **32** and **36**.

FIG. **4** is a top view of the bracket **20** of FIG. **1**.

FIG. **5** is lateral perspective view of the bracket **20** of FIG. **1** with archwires **68** and **64** located in the gingival **28** and occlusal **36** archwire retention channels to provide, e.g., torque to a tooth **76** to which the bracket may be attached.

FIG. **6** is a top view of the bracket **20** of FIG. **1** with archwires **68** and **64** located in the gingival **28** and occlusal **36** archwire retention channels to provide tip to the tooth **80** to which the bracket is attached as one skilled in the art will understand.

FIG. **7** is an end perspective view of the bracket **20** of FIG. **1** with archwires **68** and **64** located in the gingival **28** (not shown) and occlusal **36** archwire retention channels to provide rotation to the tooth **84** to which the bracket is attached as one skilled in the art will understand.

FIGS. **8**A and **8**B show an embodiment of the novel bracket **20** with different archwire configurations attached thereto.

DETAILED DESCRIPTION

Referring to FIGS. **1-8**, various embodiments of a bracket **20** are shown, wherein the bracket includes:

(a) A generally square bracket base **24** having an upper side **29**, a tooth affixing side **26**, opposing mesial-distal sidewalls **27**, and opposing gingival-occlusal sidewalls **30** as shown in FIGS. **1**, **2**A and **2**B. Additionally, the bracket base **24** has a pair of retaining ridges **25** extending from each of the opposing gingival-occlusal sidewalls **30** toward the interior of the upper side **29**. FIGS. **1** and **2**A show one of retaining ridges **25**; FIG. **3**A shows both retaining ridges. Each of the retaining ridges **25** is provided by a corresponding thickened portion **23** (FIGS. **1**, **2**A and **2**B) of the bracket base **24** that extends in the gingival-occlusal direction of the bracket **20** approximately along a gingival-occlusal center line of the bracket base **24** (e.g., along the line L of FIG. **4**). The thickened portion **23** gradually thins in the mesial-distal direction of the bracket **20**, ending with the same thickness as the sidewalls **27**.

(b) A pair of inverted archwire retaining regions **40***a* and **40***b* on the gingival side of the bracket **20** (FIGS. **1** and **2**A), and another pair of inverted archwire retaining regions **44***a* and **44***b* (FIG. **1**) on the occlusal side of the bracket. Each of the pairs (**40***a,b* and **44***a,b*) is for retaining a respective archwire (e.g., archwire **68**, FIG. **2**B) therein. In particular, each of the inverted archwire retaining regions **40***a* and **40***b* provide a recess **37** (FIGS. **1** and **2**A) for grasping or holding an archwire provided therein. Also, each of the inverted archwire retaining regions is attached to (and generally integral with) a corresponding support **39** (FIG. **2**A) that connects the retaining region with the bracket base **24**. Each support **39** extends outwardly from the upper side **29** by a distance somewhat larger than the cross section of largest archwire to be retained in the recesses **37**. Moreover, each of the recesses **37** has an edge **43** (FIGS. **2**A,B and **3**B) that is spaced apart from the support **39** for the recess, wherein the distance between the edge and the support is also somewhat larger than the cross section of largest archwire to be retained in the recesses **37**.

Note that for each of the pairs of the inverted archwire retaining regions **40***a,b* and **44***a,b*, a corresponding one of the retaining ridges **25** (FIGS. **1**, **2**A, **2**B and **3**A) assists in securing an archwire (e.g., archwire **68**) in the two recesses **37** of the pair. Accordingly, for each of the pairs **40***a,b* and **44***a,b*, the recesses **37** for the pair operatively cooperate with a corresponding one of the retaining ridges **25** to provide a corresponding archwire retention channel, i.e., for an archwire retention channel **28**, the pair **40***a,b*, defines one side of the channel **28** (i.e., an "outer" side) and the corresponding retaining ridge **25** provides the opposing side of the channel **28** (i.e., an "inner" side), and for an archwire retention channel **36**, the pair **44***a,b*, defines one side of the channel **36** (i.e., an "outer" side) and the corresponding retaining ridge **25** provides the opposing side of the channel **36** (i.e., an "inner" side). Thus, when an archwire is received (and held) in the inverted archwire retaining regions **40***a,b* or **44***a,b* (i.e., archwire retention channel **28** or **36**), this archwire is operatively coupled together with the bracket attached to a patient's tooth.

(c) Two archwire retention bridges **56** and **60** (FIGS. **1**, **2**A, **2**B, **4**, **5**A, **6** and **7**), wherein each end of each bridge attaches to one of the inverted archwire retaining regions and/or the support **39** therefor. For example, i.e., the ends of the bridge **56** may be attached to the inverted archwire retaining regions **40***a* and **44***a* (or attached to the support **39** therefor), and the ends of the bridge **60** may be attached to the inverted archwire retaining regions **40***b* and **44***b* (or attached to the support **39** therefor).

(d) An archwire retention channel **32** (FIGS. **1**, **3**A, and **5**A) extending in the mesial and distal direction along a central portion of the bracket **20**. The two archwire retention bridges **56** and **60** (together with their corresponding inverted archwire retaining regions) enclose, and substantially define, spaced apart portions of the archwire retention channel **32** for securing an archwire therein (FIG. **8**B).

The bracket base **24** may be made of a variety of materials, but in one embodiment may be stainless steel for strength. However, other materials may be used including ceramics and plastics. The remainder of the bracket **20** may be composed of various materials in addition to those recited above (e.g., polycrystalline alumina material, alumina (aluminum oxide), zirconia). In one embodiment, the bracket **20** may be formed via an injection molding technique.

The bracket base **24** may be a universal bracket design in that it can be attached to the surface of various tooth types (e.g., incisor, bicuspid, molar, etc). Moreover, such a universal bracket design does not require bracket identification to aid in identifying placement of the bracket and/or identifying a particular embodiment of the bracket **20**. Such a universal bracket design also leads to simplified inventory management since only one embodiment of the bracket **20** may be needed for placement on all teeth types instead of different embodiments of the bracket for different teeth types. However, such universal bracket design may be primarily for the lingual side of patients' teeth. For embodiments of the bracket **20** to be provided on the labial/buccal side of patients' teeth, the curvature of the tooth affixing side **26** may be specific to particu-

lar tooth types as one skilled in the art will understand. Accordingly, it is also within the scope of the present disclosure that markings or identifications may be provided on embodiments of the bracket **20** for identifying the bracket (e.g., as a universal bracket, or specific to a particular tooth type(s)), for identifying the manufacturer or distributor of the bracket, and/or for identifying a particular placement or orientation of the bracket on a tooth or tooth type. Note that descriptions of providing such markings and/or identifications are disclosed in U.S. Patent Application Publication 2008/0020338 filed Jul. 24, 2007 and published Jan. 24, 2008, this application being fully incorporated herein by reference.

The bracket base **24** design allows for the bracket **20** to be used in both direct and indirect bonding. Note that the term direct bonding refers to applying adhesive directly to a patient's tooth and subsequently attaching a bracket **20** thereto. Indirect bonding refers to positioning one or more brackets **20** on a dental cast of a patient's teeth. The dental cast, having the brackets **20** attached thereto, is then surrounded with a material, wherein the material, once solidified, secures the brackets therein and can act as a transportation device for the brackets once the dental cast is dissolved away. Adhesive is then applied to the back of each of the brackets **20** prior to placing the transportation device containing the brackets onto the patient's teeth. Accordingly, in the indirect bonding technique, all of the brackets **20** are bonded to the patient's teeth simultaneously. Once the brackets **20** are bonded, the transportation device is removed from the teeth, leaving behind the brackets attached to the teeth.

Regarding the retaining ridges **25** described above, each such ridge corresponds to a maximal offset from the tooth affixing side **26** along a corresponding one of the archwire retention channels **28** and **36**. Moreover, in at least some embodiments, such a ridge **25** has its maximal offset centered on line L of FIG. **4**. In the embodiment of the bracket **20** shown in FIGS. **2**A and **2**B, the contour of each of the retaining ridges **25** is a smooth arc without undulations in the mesial-distal direction, and may also be a smooth arc in the gingival-occlusal direction without undulations. However, it is within the scope of the present disclosure that in the gingival-occlusal direction, such a ridge **25** may reach its maximal offset at any point where the ridge transverses its corresponding archwire retention channel (**28** or **36**) as long as the ridge effectively assists in wedging or holding an archwire in the channel (i.e., the recesses **37** of the channel). Thus, the thickened portion **23** (FIG. **1**) for each retaining ridge **25** may induce a force upon an archwire **68** or **64** (e.g., FIG. **5**A) to retain it in the archwire retaining regions of the corresponding archwire retention channel **28** or **36**. Note that each of the two retaining ridges **25** may have symmetrical profiles (i.e., mirror images of one another about the center line L of FIG. **4**, and about mesial-distal center line through the bracket). Moreover, note that the maximal offset for a retaining ridge **25** may occur just outside its corresponding archwire retention channel, e.g., on the mesial-distal perimeter of the channel furthest from the central retention channel **32**. Such placements of the maximal offsets may not only provide forces for securing an archwire within the corresponding recesses **37**, but also apply a force on the archwire for inhibiting the archwire from moving in a direction generally lateral to the upper side **29**.

In another embodiment of the bracket **20**, the retaining ridges **25** may have a larger or smaller maximal offset from the tooth affixing side **26** to the upper side **29** of the bracket base **24** when compared to the embodiments of the figures. Moreover, one of the retaining ridges **25** may have a larger maximal offset from the tooth affixing side **26** than the other retaining ridge **25**. This variance in the maximal offset of the retaining ridges **25** may allow for and aid in the retention of different diameter archwires in the retaining regions **40***a,b* and **44***a,b*.

In another embodiment of the bracket **20**, one or more of the retaining ridges **25** may have a corresponding secondary retaining ridge located at the gingival or occlusal edges of the bracket base **24**. These secondary retaining ridges may be located on the upper side **29** at the gingival and/or occlusal edges of the bracket base **24**. Such secondary retaining ridges may extend in the mesial-distal direction on the upper side **29** of the bracket base **24**. The secondary retaining ridges may have varying shapes (e.g., hemispherical or elliptical). Accordingly, the retaining regions **40***a,b* and **44***a,b*, in conjunction with the secondary retaining ridges, keep the corresponding archwire secured in one of the corresponding archwire retention channels **28** and **36** (more specifically their recesses **27**).

For further description of the archwire retention channels **28**, **32** and **36**, reference is made to FIG. **3**A which provides a lateral (side) view of the bracket **20** along a gingival-occlusal side. The center archwire retention channel **32** of the bracket **20** is enclosed by the two spaced apart portions of the archwire retention bridges **56** and **60** (FIGS. **1**,**2**A, **2**B, **4**, **5**A, **6** and **7**), and the upper side **29** of the bracket base **24**. As described above, each of the gingival archwire retention channel **28** and the occlusal archwire retention channel **36** is provided by: (i) partially enclosed spaced apart recesses **27** of a pair of inverted archwire retaining regions, respectively, **40***a,b* or **44***a,b*, and (ii) the upper side **29** of the bracket base **24**. Both the gingival archwire retention channel **28** and the occlusal archwire retention channel **36** may be mirror images of one another. Each of the inverted archwire retaining regions **40***a,b* for the gingival archwire retention channel **28**, and each of the retaining regions **44***a,b* for the occlusal archwire retention channel **36** may be generally circular in profile (as shown in, e.g., FIG. **3**A). Each such profile may generally match the curvature of, e.g., the cross section of a corresponding archwire to be provided therein. In FIG. **3**A, a dashed circular cross section **38** of such an archwire is shown in the archwire retaining regions **44***a,b* of the occlusal archwire retention channel **36**. The diameter **39** of the archwire retention channel **36** may be sufficiently surrounded by the inverted archwire retaining regions **44***a,b* to grip and retain the archwire therein. In at least one embodiment, the opening **42** for receiving the archwire into the channel **36** is preferably approximately the same size as the diameter of the archwire cross section **38** along the axis **37**, e.g., smaller or larger by approximately 0.01 to 0.02 inches. As also illustrated in FIG. **3**A, each of the inverted archwire retaining regions **44***a,b* may surround somewhat more than 180 degrees of the circular cross section of an archwire positioned in the occlusal archwire retention channel **36**. Note that a similar description can also be provided for the gingival archwire retention channel **28** in that the channel **28** may be a mirror image of occlusal archwire retention channel **36**. However, it is within the scope of the present disclosure that the gingival archwire retention channel **28** may be configured differently from the occlusal archwire retention channel **36**, e.g., the gingival archwire retention channel **28** may secure different sizes of archwires therein from the archwires for the occlusal archwire retention channel **36**. Also, either or both of the archwire retention channels **28** and **36** may have an elliptical profile or other profile instead of the circular profile shown in FIG. **3**A. Further, an embodiment of the bracket **20** may have only one of the archwire retention channels **28** or **36**.

Referring to FIG. **3**B, an embodiment of the bracket **20**A is shown that includes a retaining region (e.g., **44***a*) that is shaped or configured to retain archwires having substantially different cross sectional diameters. An archwire having a diameter **39** (FIG. **3**A) may be snapped into the retaining region **44***a* as indicated in FIG. **3**A. However, an archwire having a much smaller cross section **41**, as shown in FIG. **3**B, may also be provided in the channel **36**. In particular, the smaller diameter archwire may snap into (or is otherwise retained) in an upper section **57** of the retaining region. Note that in one embodiment, a bead (not shown) may be strung on this smaller diameter archwire such that the bead is positioned between the retaining regions **44***a* and **44***b* so that the bead contacts the corresponding retaining ridge **25** for the occlusal archwire retention channel **36** in a manner that assists in locking the archwire into the upper section **57**.

Whether the bracket embodiment of FIG. **3**A or **3**B is provided, multiple sizes of archwires may be utilized in each of the archwire retention channels **28**, **32** and **36**. The range in the maximal cross sectional extent of the archwires that may be utilized can be from 0.008 inches to 0.024 inches, and such cross sections may be generally circular in cross sectional shape but different cross sectional shapes may be used, e.g., at least rectangular or square cross sectional shapes for the central archwire retention channel **32**. The multiple sizes of archwires may provide varying forces and friction levels ranging from an alignment force having a low friction, to a leveling force having a moderate friction, to a finishing force having a maximum friction as one skilled in the art will understand. In particular, the inverted archwire retaining regions **40***a,b* and **44***a,b* allow for the archwires **68** or **64** (FIGS. **5**A, **6** and **7**) to be attached to the bracket **20** without the use of ligatures.

In another embodiment, the archwire retaining regions **40***a* and **44***a* (or **40***b* and **44***b*) may be joined together, above the upper side **29**. Such joining of the retaining regions for one of the archwire retention channels **28** or **26** may form a single integral retaining region, or the joining may be in form of a bridge therebetween similar to the bridges **56** and **60** (except extending in the mesial-distal direction rather than the gingival-occlusal direction). Regardless, there may be a cutout (not shown) over the corresponding retaining ridge **25** so that when the archwire contacts the retaining ridge **25**, the archwire is wedged into this cutout. In another embodiment, there may be only one of the outer archwire retention channels **28** and **36** utilized to retain an archwire.

Referring to FIG. **4**, a top view of the bracket **20** is shown wherein the center archwire retention channel **32** on the bracket is defined by the spaced apart portions of the archwire retention bridges **56** and **60** and the upper side **29** of the bracket base **24**. The archwire retention bridges **56** and **60** connect and reinforce the inverted archwire retaining regions **40***a* to **44***a* and **40***b* to **44***b*. The smooth rounded contours and edges **65** of the inverted archwire retaining regions **40***a,b* and **44***a,b* provide for patient comfort, particularly when such brackets are placed on the lingual side of a patient's teeth. In the center archwire retention channel **32**, the archwire is enclosed on all sides (FIGS. **3**A and **3**B) at two points along the channel, i.e., using the archwire retention bridges **56** and **60** (FIG. **4**).

A lateral view of the bracket **20**, as shown in FIG. **5**, shows an archwire **64** in the occlusal archwire retention channel **36** and an archwire **68** in the gingival archwire retention channel **28**. The occlusal **64** and gingival **68** archwires are held place via the friction system created by the inverted archwire retaining regions **40***a,b* and **44***a,b* in combination with the ridges **25** (not shown in FIG. **5**). FIG. **5** also shows where the bracket **20** may reside on a tooth when it is bonded thereto. The arrows **77** and **78** (FIG. **5**) indicate the forces for a torque that the bonded bracket **20** may apply to the tooth.

FIG. **6** provides a top view of the bracket **20** bonded to a tooth **80** wherein there is an archwire **64** in the occlusal archwire retention channel **36**, and an archwire **68** in the gingival archwire retention channel **28**. The arrows **90** and **91** indicate the motion of tip (angulation) that the bracket **20** may apply to the tooth once it is bonded and the archwires are configured appropriately.

An end perspective view of the bracket **20** is shown in FIG. **7** with an archwire **64** in the occlusal archwire retention channel **36** and an archwire **68** in the gingival archwire retention channel **28**. This figure also shows the bracket bonded to a tooth **84** thereby showing where the bracket **20** may reside on the tooth when it is bonded thereto. The arrows **93** and **94** indicate the motion of rotation that the bracket **20** and the archwires **64** and **68** may apply to the tooth.

A plurality of the brackets **20** is shown connected together by archwires in FIGS. **8**A and **8**B. FIG. **8**A shows the plurality of brackets **20** connected together by an archwire **88** extending through the corresponding occlusal archwire retention channels **36** of the brackets. FIG. **8**A also shows a second archwire **92** secured in the center archwire retention channel **32** of the brackets **20**, providing dynamic sectional control in the movement of the teeth, as one skilled in the art will understand. FIG. **8**B displays how another configuration, wherein there is an archwire **96** in the occlusal archwire retention channel **36** of the brackets **20**. The archwire **96** is also configured so that its end is secured in the center archwire retention channel **32** of the rightmost one of the brackets **20**, thereby creating a loop like shape. It is worth noting that due to the diminutive size of the brackets **20** relative to the teeth to which they are attached (as shown in FIGS. **8**A and **8**B), the size of these brackets **20** may allow for the bonding of two such brackets **20** on a single tooth. For example, FIG. **8**B shows two such brackets **20** affixed to a molar.

Alternative embodiments of the bracket **20** include providing the inverted archwire retaining portions so that instead of their recesses **37** opening toward the base **24**, such recesses open in another direction (e.g., away from the base, or generally parallel with the upper side **29** of the base). In such embodiments, the retaining ridge **25** is also repositioned to face in the direction toward such recesses for retaining an archwire in the same manner as, e.g., shown in FIG. **2**B except that the base **24** in this figure would no longer be the base of the bracket. Instead, the base would attach, e.g., to the top of the retaining portions **40***a,b* and **44***a,b*, or alternatively attach the bracket components shown FIG. **2**B to a (new) bracket base that is oriented substantially perpendicular to the base shown in FIG. **2**B.

In each of the embodiments of the bracket **20** disclosed hereinabove, at least one of the archwire retention channels **28** and **36** is provided, wherein for an archwire provided therein, the elasticity of the archwire to retain an initial non-curved shape causes the archwire to resist the channel induced bow in the archwire (such curving shown in FIG. **2**B). Thus, as an orthodontist positions the archwire in the at least one channel of the bracket **20**, the corresponding retaining regions (**40** and **44**) for the channel together with the corresponding retaining ridge **25** bind or wedge the archwire within the at least one channel. Accordingly, the opposing forces between the channel and archwire are believed to secure the archwire within the channel. Thus, it is a feature of the bracket **20** that for each such archwire channel (e.g., **28** and/or **36**), there are channel archwire bowing portions that retain the archwire within the channel, wherein a spaced apart

plurality of these bowing portions (e.g., **40***a* and **40***b* for channel **28**) contact the archwire at spaced apart locations on one side of the archwire's length, and wherein between such locations, there is at least one additional channel archwire bowing portion on an opposite side of archwire for inducing the archwire to press against the spaced apart plurality of contacting portions. Thus, the spaced apart plurality of bowing portions, and the at least one additional bowing portion induce oppositely directed forces on the archwire (such forces being traverse to the length of the archwire), and causing the archwire to bow or bend somewhat and to press against these bowing portions for holding the archwire within the channel.

In use, after an orthodontist has secured the bracket **20** to one of a patient's teeth, the orthodontist may exert a force (e.g., substantially parallel to the upper side **29**) on a corresponding archwire to force the archwire enter one or both of the archwire retention channels (**28** or **36**), wherein such force induces the corresponding archwire to bow in the channel. Alternatively, the orthodontist may thread the archwire into such a channel, wherein the orthodontist pushes the archwire into the channel by purposely bowing or binding the archwire to follow the bow of the channel, and then once the archwire is threaded through the channel, the orthodontist can then bend the archwire into the correct orientation to attach the archwire to, e.g., a next orthodontic appliance attached to, e.g., a next tooth. Note, that such subsequent bending of the archwire by the orthodontist is believed to also provide similar forces on the archwire (and traverse to the length thereof) as described above for securing the archwire within the channel.

The disclosure herein describes the best mode known to carry out the invention as claimed in the claims hereinbelow. Moreover, the foregoing disclosure has been provided for purposes of illustration and description. This disclosure is not intended to limit the invention claimed hereinbelow, and various embodiments thereof. Variations, embodiments and modifications will be apparent to those skilled in the art and are intended to be within the scope of the following claims.

What is claimed is:

1. A method for adjustment of a patient's tooth using an orthodontic appliance, wherein the appliance has mesial and distal archwire retaining portions on opposite sides of a bracket with respective retaining ridges, the method comprising applying a force to an archwire positioned within a patient's mouth for inducing a predetermined bow when the archwire enters an archwire retaining channel, wherein the mesial and distal archwire retaining portions are on a first side of the channel and a retaining ridge is on an opposing side contacting the archwire at a location between the mesial and distal archwire retaining portions for providing the predetermined bow in the archwire in a direction towards the first side.

2. The method as set forth in claim **1**, wherein a shape of the bracket retains the archwire.

3. The method as set forth in claim **1**, wherein the archwire retaining portions are configured to grasp the archwire.

4. The method as set forth in claim **1**, wherein the archwire retaining portions are configured for mating with more than 180° about the archwire.

5. The method as set forth in claim **1**, wherein each of the mesial and distal archwire retaining portions include a configuration for mating with more than 180° about two different archwires, wherein the two different archwires have different cross-sectional extents.

6. The method as set forth in claim **1**, wherein the bracket has a base and at least one of the retaining portions has a recess that opens toward the base.

7. The method as set forth in claim **1**, wherein the retaining ridge is opposite a gap along the archwire retaining channel.

8. The method as set forth in claim **1**, wherein the bracket has a base and at least one of the retaining portions has a recess that opens away from the base.

9. The method of claim **1**, wherein the archwire is caused to bow in a fashion that holds the archwire within the archwire retaining channel.

10. The method of claim **1**, wherein the archwire retaining portions have smooth contours and edges.

11. The method of claim **1**, wherein the archwire is attached to the bracket without the use of ligatures.

12. The method of claim **1**, wherein the archwire retaining portions are inverted.

13. A method for adjustment of a patient's tooth using an orthodontic appliance, comprising:

securing an orthodontic appliance to a patient's tooth, wherein the appliance includes:

(a) a tooth attachment side for attaching to a tooth, and an outer side for facing away from the tooth;

(b) mesial and distal archwire retaining portions for retaining an archwire in a first archwire retaining channel, each of the mesial and distal archwire retaining portions having a corresponding recess for receiving the archwire;

(c) a first retaining ridge for holding the archwire in the corresponding recesses, the first retaining ridge extending away from the tooth attachment side further than distal and mesial ends of the first archwire retaining channel;

(d) second mesial and distal archwire retaining portions for retaining a second archwire in a second archwire retaining channel, each of the second mesial and distal archwire retaining portions having a corresponding additional recess for receiving the second archwire;

(e) a first bridge extending between and fixedly connecting the mesial archwire retaining portion and the second mesial archwire retaining portion;

(f) a second bridge extending between and fixedly connecting the distal archwire retaining portion and the second distal archwire retaining portion; and

(g) wherein the each of the first and second bridges enclose a part of an archwire retention channel between the first and second archwire retaining channels;

providing the archwire in an open side along a length of the first archwire retaining channel for receiving the archwire in the first archwire retaining channel;

applying a force to the archwire for inducing a predetermined bow therein when the archwire enters the first archwire retaining channel, wherein the mesial and distal archwire retaining portions are on a first side of the first archwire retaining channel, and the first retaining ridge is on an opposing second side of the first archwire retaining channel, and contacts the archwire at a location between the mesial and distal archwire retaining portions for providing the predetermined bow in the archwire in a direction toward the first side;

providing the second archwire in an open side along a length of the second archwire retaining channel for receiving the archwire in the second archwire retaining channel;

applying a force to the second archwire for inducing a predetermined second bow therein when the second archwire enters the second archwire retaining channel, wherein the second mesial and second distal archwire retaining portions are on a first side of the second arch-

wire retaining channel, and a second retaining ridge is on an opposing second side of the second archwire retaining channel, and contacts the second archwire at a location between the second mesial and second distal archwire retaining portions for providing the predetermined second bow in the second archwire in a direction toward the first side of the second archwire retaining channel;

wherein the archwire retaining portions are configured to grasp the archwire; and

wherein the first retaining ridge is opposite a gap along the first archwire retaining channel.

14. The method of claim **13**, wherein the archwires are generally rectangular or square in cross sectional shape.

15. The method of claim **13**, wherein the archwire retaining portions are inverted.

16. The method of claim **13**, wherein the archwire retaining portions have rounded contours and edges.

17. The method of claim **13**, wherein said archwire retaining portions have recess openings directed away from the base.

18. The method of claim **13**, wherein the archwire retention channel has an elliptical profile.

19. The method of claim **13**, wherein the archwire is attached to the bracket without the use of ligatures.

20. A method for adjustment of a patient's tooth using an orthodontic appliance, wherein the appliance has mesial and distal archwire retaining portions on opposite sides of a bracket with respective retaining ridges, the method comprising applying a force to an archwire positioned within a patient's mouth for inducing a predetermined bow when the archwire enters an archwire retaining channel, wherein the mesial and distal archwire retaining portions are on a first side of the channel and a retaining ridge is on an opposing side contacting the archwire at a location between the mesial and distal archwire retaining portions for providing the predetermined bow in the archwire in a direction towards the first side;

wherein a shape of the bracket retains the archwire;

wherein the archwire retaining portions are configured to grasp the archwire;

wherein said appliance further includes a first bridge extending between and fixedly connected to the distal archwire retaining portions on opposite sides of the bracket; and

wherein the archwires have a cross sectional extent from 0.008 inches to 0.024 inches.

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